

12236

CIA HISTORICAL REVIEW PROGRAM
RELEASE IN FULL

ECONOMIC INTELLIGENCE REPORT

COPPER IN THE SEVEN YEAR PLAN (1959-65)
OF THE USSR



CIA/RR ER 60-19

July 1960

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

NOTICE

This report has been loaned to the recipient by the Central Intelligence Agency. When it has served its purpose it should be destroyed or returned to the:

CIA Librarian
Central Intelligence Agency
Washington 25, D. C.

ECONOMIC INTELLIGENCE REPORT

COPPER IN THE SEVEN YEAR PLAN (1959-65)
OF THE USSR

CIA/RR ER 60-19

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

FOREWORD

This report analyzes the current status of the copper industry of the USSR and presents a continuous time series of production of refined copper in that country from 1938 (the last year for which the USSR announced a production figure) through 1959. An estimate for 1965 also is given, based on the percentage increase announced in the Seven Year Plan (1959-65).

The time series is based exclusively on information extracted from Soviet newspapers, periodicals, and books. A Soviet source is given for each figure in the series, or the methodology for the figure is explained in detail. Close attention to sources and methods has yielded estimates that are believed to be a close approximation to the actual production of refined copper in the USSR.

CONTENTS

	<u>Page</u>
Summary and Conclusions	1
I. Production	2
A. Quantity	2
B. Reserves	6
C. Mining and Concentrating	7
D. Smelting and Refining	9
II. Construction and Investment	9
III. Consumption	15
IV. Substitution	16
V. Trade	16
A. Imports	16
B. Exports	17
VI. Relationship Between Supply and Consumption	18

Appendix

Source References	19
-----------------------------	----

Tables

1. Estimated Production of Refined Copper in the USSR, 1913, 1937-59, and 1965 Plan	3
2. Mining and Concentrating, Smelting, and Refining Plants and Production in the Copper Industry of the USSR, 1958	10
3. Expansion of the Copper Industry of the USSR During the Seven Year Plan, 1959-65	13
4. Estimated Supply and Consumption Balance of Copper in the USSR, 1954-59 and 1965 Plan	18

[p. iv blank]

Illustrations

Following Page

Figure 1. The Copper Industry of the USSR, 1959 (Map)	10
Figure 2. Estimated Supply and Consumption Balance of Copper in the USSR, 1954-59 and 1965 Plan (Chart)	18

COPPER IN THE SEVEN YEAR PLAN (1959-65)
OF THE USSR

Summary and Conclusions

Although the USSR has the largest reserves of copper in the world, it has been dependent on imported supplies of that metal for many years. Increases in production of copper have been scheduled in each of the six Five Year Plans, but actual production, although steadily rising, has consistently fallen short of goals. Particularly during the period since World War II, a moderate increase in production of copper has taken place, and there has been a rapid growth of the Soviet economy accompanied by an even faster rate of growth in the consumption of copper. Consequently, the gap between domestic production and consumption of copper has not been closed, and the USSR has had to augment its domestic production by importing copper from the Free World and, since World War II, by withdrawing supplies from copper stocks accumulated during the war.

In the Seven Year Plan (1959-65) the USSR again has scheduled a substantial increase in production of refined copper. The goal for 1965 is 90 percent above the estimated production in 1958 of about 406,000 metric tons,* or about 772,000 tons. Production of copper in 1959 was approximately 416,000 tons. Achievement of the goal for 1965 will depend in large part on whether or not the program for the construction of additional capacity, particularly ore-concentrating facilities, is completed on schedule. As far as can be determined, the planned investment in the copper industry appears to be adequate to construct the facilities necessary for meeting the planned increase. In view of the Soviet record of failing to complete the construction programs in the copper industry and also in view of recent complaints of delays in construction that have been made in the Soviet press and in radiobroadcasts, attainment of the 90-percent increase by 1965 appears doubtful at this time.

Along with the efforts to increase production of copper, the USSR is attempting to slow down the rate of growth of consumption of copper by pursuing vigorously a program of substitution. Among the measures being stressed at the present time is the substitution of aluminum for copper in a variety of applications. During 1959-65, more than 1 million tons of aluminum are planned to be consumed by the wire and cable industry, thus saving, among other things, an average of about

* Tonnages are given in metric tons throughout this report.

60,000 tons of copper per year. Although there is little doubt that the USSR will both increase the level of production of copper and stretch to the maximum the current supplies of copper by stringent conservation measures and substitution wherever practicable, the gap between production and consumption probably will not be closed by 1965. Therefore, the USSR is expected to continue to import copper from the Free World during the period of the Seven Year Plan.

I. Production

A. Quantity

The USSR has not announced the quantity of copper produced in the country as a whole or in any of its regions since 1938. In that year an official report stated that the total production of copper was 103,200 tons, of which 83,700 tons were from ore. Presumably the balance was obtained from processing copper scrap. Other statements in the prewar Soviet press make it possible to establish firm production figures for 1939 and 1940. Although annual percentage increases have been published for most postwar years, such data must be applied to a tonnage figure as a base to obtain a production figure in absolute terms. Uncertainty about the magnitude of this base, usually taken to be production in 1945, has given rise to a number of estimates, both here and abroad, of production of copper in the USSR in the period since World War II.

The conjecture on this subject came to an end when three pieces of information concerning achievements during the Fifth Five Year Plan (1951-55) were published, as follows: (1) production of blister copper in Kazakh SSR in 1955 was 79 percent greater than in 1950, (2) Kazakh SSR in 1955 produced 44 percent of the total production of copper in the USSR, and (3) the total production of copper in the USSR in 1955 increased 53 percent above the level in 1950. These three statements can be related to the announced increase in production of copper in Kazakh SSR in 1950 above the level in 1940 and to other data previously published to yield a complete series of production figures based wholly on information released by Soviet authorities themselves.

The USSR is estimated to have increased its production of refined copper about 12-1/2 times during the past 46 years, from 31,000 tons in 1913 to about 416,000 tons in 1959. For comparison, production of refined copper in the US has about doubled during the

same period, having increased from about 600,000 tons to about 1.2 million tons. Estimates of the Soviet production of refined copper for 1913 and 1937-59 and the plan for 1965 are presented in Table 1.*

Table 1

Estimated Production of Refined Copper in the USSR
1913, 1937-59, and 1965 Plan

Thousand Metric Tons			
Year	Amount	Year	Amount
1913	31.0 <u>a/</u>	1948	186.8 <u>j/</u>
1937	97.6 <u>b/</u>	1949	224.2 <u>k/</u>
1938	103.2 <u>c/</u>	1950	246.6 <u>l/</u>
1939	142.5 <u>d/</u>	1951	281.1 <u>m/</u>
1940	161.0 <u>e/</u>	1952	323.3 <u>n/</u>
1941	186.8 <u>f/</u>	1953	320.8 <u>o/</u>
1942	164.0 <u>f/</u>	1954	336.8 <u>p/</u>
1943	141.3 <u>f/</u>	1955	377.3 <u>q/</u>
1944	147.5 <u>f/</u>	1956	386.7 <u>r/</u>
1945	134.7 <u>g/</u>	1957	396.4 <u>r/</u>
1946	142.8 <u>h/</u>	1958	406.3 <u>r/</u>
1947	155.7 <u>i/</u>	1959	416.5 <u>r/</u>
		1965 Plan	772.0 <u>s/</u>

- a. 1/. (For serially numbered source references, see the Appendix.)
b. In 1938, 5.7 percent more copper was smelted than in 1937. 2/
Production in 1938 is known, and production in 1937 was derived.
c. 3/
d. Production of copper in 1939 was 46 percent greater than in 1937. 4/
e. Production of copper in 1940 was 65 percent greater than in 1937. 5/
f. Figures for production of copper in the USSR during 1941-44 were derived on the basis of information about production in Kazakh SSR and its relation to production in the USSR. Production of copper in Kazakh SSR during the first 7 months of 1944 was 69.4 percent above the corresponding period in 1940, 26.3 percent above the corresponding period in 1941, and 18 percent above the corresponding period in 1943. 6/ On the basis of these statements, the following index of production of copper in Kazakh SSR has been derived:

* Text continued on p. 6.

Table 1

Estimated Production of Refined Copper in the USSR
1913, 1937-59, and 1965 Plan
(Continued)

<u>Year</u>	<u>Index</u> <u>(1940 = 100)</u>
1941	134.1
1943	143.6
1944	169.4

This index applies only to the first 7 months of each year. New capacity was being installed at the Balkhash plant in 1940, and thus an unusually large proportion of production in Kazakh SSR took place during the latter months of that year. The rate of production during the last 5 months of 1940 is estimated to have been the same as during the first 7 months of 1941 -- that is, about 34 percent greater than during the first 7 months of 1940. The average monthly production of copper in Kazakh SSR in 1940, therefore, was derived as follows:

x = the average monthly rate of production during
the first 7 months of 1940

$1.34x$ = the average monthly rate of production during
the last 5 months of 1940

$7x + 5 (1.34x) = 35,490$ metric tons (the amount of copper
smelted in Kazakh SSR
in 1940 was seven
times as great as that
in 1913. 7/)

$7x + 6.7x = 35,490$ metric tons

$x = 2,591$ metric tons, the average monthly production during
the first 7 months of 1940

1.34 times $2,591 = 3,472$ metric tons, the average monthly
production during the last 5 months of
1940

Production in Kazakh SSR in 1941 is therefore estimated to have been about 41,664 metric tons (the average monthly production of 3,472 metric tons during the first 5 months of 1940 times 12). Kazakh SSR produced 22.3 percent of the total produced in the USSR in 1941. 8/ which is therefore estimated to have been 186,800 metric tons. The figure for production in 1942 is interpolated. Production in Kazakh SSR in 1943 is estimated to have been about 44,648 metric tons (the average monthly production of 2,591 metric tons during the first 7 months of 1940 times 12 times 1.436). Kazakh SSR produced 31.6 percent of the total produced in the USSR in 1943, 9/ which is

Table 1

Estimated Production of Refined Copper in the USSR
1913, 1937-59, and 1965 Plan
(Continued)

therefore estimated to have been 141,300 metric tons. Production in Kazakh SSR in 1944 is estimated to have been about 52,670 metric tons (the average monthly production of 2,591 metric tons during the first 7 months of 1940 times 12 times 1.694). Kazakh SSR produced 35.7 percent of the total produced in the USSR in 1944, 10/ which is therefore estimated to have been 147,500 metric tons.

g. Derived from production in 1946, which was 6 percent greater than in 1945. 11/

h. Derived from production in 1947, which was 9 percent greater than in 1946. 12/

i. Derived from production in 1948, which was 20 percent greater than in 1947. 13/

j. Derived from production in 1949, which was 20 percent greater than in 1948. 14/

k. Derived from production in 1950, which was 10 percent greater than in 1949. 15/

l. Derived from production in 1955, which was 53 percent greater than in 1950. 16/ Another source reported that production in 1950 was 82 percent greater than in 1945, 17/ or 245,200 metric tons in 1950, which is close to the figure given in the table.

m. Production of copper in 1951 was 14 percent greater than in 1950. 18/

n. Production of copper in 1952 was 15 percent greater than in 1951. 19/

o. Derived from production in 1954, which was 5 percent greater than in 1953. 20/

p. Derived from production in 1955, which was 12 percent greater than in 1954. 21/

q. Estimated from production in Kazakh SSR and the percentage of the total production in the USSR accounted for by Kazakh SSR. In 1955, Kazakh SSR produced 44 percent of the copper produced in the USSR. 22/ Production by Kazakh SSR in that year is estimated to have been about 166,000 metric tons. This figure was derived by linking production in Kazakh SSR in 1940 to that in 1913, production in 1950 to that in 1940, and production in 1955 to that in 1950. Production in 1940 was seven times that in 1913, 23/ or 35,490 metric tons. The planned production of copper in Kazakh SSR in 1950 was to be 260 percent of production in 1940, 24/ or 92,274 metric tons. The Fourth Five Year Plan (1946-50) for production of copper in Kazakh SSR was fulfilled by 100.5 percent. 25/ In 1955, production of blister copper in Kazakh SSR was 79 percent greater than in 1950. 26/

Table 1

Estimated Production of Refined Copper in the USSR
1913, 1937-59, and 1965 Plan
(Continued)

r. The USSR has not published figures for annual percentage increases in production of copper since 1955. There probably was some increase in production during 1956-59 but less than both the planned increases and the increases in previous years. The smallest annual increase known to have been announced by the USSR during the period under consideration is 5 percent. If the USSR had increased production in any of the years 1956-59 by as much as 5 percent, an announcement probably would have been made to this effect. On the assumption that some increase in production was achieved and that it was less than 5 percent, a figure of 2.5 percent was selected as the annual increase for the 4 years 1956-59.

s. Production of copper planned for 1965 is 90 percent greater than in 1958. 27/

The USSR also has announced that production of refined copper in 1965 is to be 90 percent greater than in 1958. Thus the goal for production of refined copper is estimated to be 772,000 tons, or an average annual increase of 9.6 percent above the level in 1958. This large increase may indicate the failure of the Soviet copper industry to increase production in the first 3 years of the original Sixth Five Year Plan (1956-60) by anything like the amounts called for in that plan. Whereas production was scheduled to grow by 9.6 percent annually during 1956-60, it is estimated to have grown only by about 2.5 percent annually in the first 4 years of the Sixth Five Year Plan. The major reason for the failure to meet the goals for production of copper in the early years of this plan as well as the goal of the Fifth Five Year Plan (1951-55) is believed to have been the unfulfilled construction goals for various enterprises of the copper industry, particularly in the mining and concentrating sectors.

B. Reserves

The USSR has stated that it leads the world in reserves of copper. 28/ This allegation, which implies nothing about the quality of the reserves, may be true -- no other country is known to have reserves that are larger than those claimed by the USSR. The copper content of the Soviet copper reserves at the beginning of 1959 is estimated to have been about 35.2 million tons. This quantity represents an increase of about 80 percent above the level of 19.5 million

tons of reserves in 1939, the last year for which the USSR reported a tonnage figure for reserves. During the Seven Year Plan (1959-65) the USSR hopes to increase the surveyed reserves of copper by 35 to 40 percent. 29/ If this goal is achieved, reserves of copper in 1965 should amount to between 44 million and 45 million tons -- that is, 48 million to 49 million tons minus the amount of ore mined during the Seven Year Plan.

Approximately 90 percent of the copper reserves of the USSR at the end of 1958 were located in four general areas in 1958, as shown in the following tabulation:

<u>Area</u>	<u>Percent</u>
Armenian SSR	10
Urals	15
Kazakh SSR	50
Uzbek SSR	15
Other	10
Total	<u>100</u>

Most of the copper deposits are in complex rock formations, which have been subjected to considerable alteration and deformation. The ores generally are polymetallic and include a variety of copper-bearing minerals. Many of the deposits of copper in the USSR are of relatively low grade and contain large quantities of oxide ores, which require different processes and equipment from those required by sulfide ores. The USSR has been processing both types of ore with the same techniques, with the result that recovery of copper from oxide ores has been low.

C. Mining and Concentrating

Little quantitative information has been released by the USSR in the last 20 years regarding production of copper ores and concentrates. Considerable data of a qualitative nature have been published, however, particularly about ores and processes in the Urals and the Armenian SSR. These data indicate that the mining and concentrating processes are lagging behind the smelting and refining processes and that the metal content of the ores has been declining.

Kazakh SSR leads all other areas in the USSR in production of copper ore, followed by the Urals, Noril'sk, and the Armenian SSR.

Soviet production of copper ore in 1958 was distributed among these areas approximately as follows:

<u>Area</u>	<u>Percent of Total Production in the USSR</u>
Kazakh SSR	55
Urals	20
Noril'sk	20
Armenian SSR	5
Total	<u>100</u>

The mining and concentrating operations in Kazakh SSR are carried on in the Dzhezkazgan-Karsakpay area, the Balkhash-Kounradskiy area, and the Altay area of East Kazakhstan. The largest copper mine and concentrating plant in the USSR is in the Balkhash-Kounradskiy area. During the Seven Year Plan, large new mines and concentrating plants are to be constructed at Bozshakul', Chetyr-Kul'sk, Nikolayevsk, and Dzhezkazgan.

In the Urals, where copper has been mined for many centuries, the principal mines are at Krasnoural'sk, Kirovgrad, Degtyarka, Karabash, Sibay, and Blyava. Each of the mines has its own concentrating plant except Degtyarka, which ships its ore a few miles northward to a concentrating plant at Revda. Mining and concentrating at Volkov, Uchaly, and Gaysk are to begin during the Seven Year Plan.

One of the largest mining-metallurgical combines in the USSR is at Noril'sk in Krasnoyarskiy Kray. The Noril'sk ore is different from the other copper ores in the USSR in that it resembles the nickel-copper ore of the Sudbury district in Ontario, Canada. During the Seven Year Plan, production at Noril'sk is to double.

In the Armenian SSR, copper ore is mined and concentrated at four localities -- Akhtala-Shamlug, Dastakert, Kadzharan, and Kafan. At present, each of these operations is relatively small in scale. During the Seven Year Plan a large porphyry copper deposit at Agarak is to be developed for open-cut exploitation, and a concentrating plant of commensurate size is to be constructed in the vicinity.

In Uzbek SSR, copper ore is to be mined and concentrated for the first time during the Seven Year Plan. The oxidized ores from the Kal'makir mine are to be processed at a new concentrating plant near the mine.

For a listing of the principal copper mines in the USSR, see Table 2,* and for an indication of the location of these mines, see the map, Figure 1.**

D. Smelting and Refining

Copper smelting is concentrated in two areas of the USSR, the Urals and Kazakh SSR, where approximately three-fourths of the total production of the country is smelted. Lesser amounts of blister copper are produced in Noril'sk, Moscow, and the Armenian SSR and on the Kola Peninsula.

Five or six copper smelters are in the Urals. They are situated at Krasnoural'sk, Kirovgrad, Revda, Karabash, and Mednogorsk, and there may be one at either Sibay or Baymak. Although none of these smelters is particularly large, collectively they make the Urals the second largest producing area in the country. The copper smelters in Kazakh SSR are located at Balkhash, Karsakpay, and Glubokoye, with the one at Balkhash being the largest in the country. Other copper smelters are at Alaverdi, Moscow, Noril'sk, and Monchegorsk.

By far the largest percentage of production of refined copper in the USSR came from the Urals in 1958. This area accounted for about one-half of the total production of refined copper in the country and was followed by Kazakh SSR, which accounted for one-fourth. The Urals area also has the largest refinery in the USSR, situated at Verkhnyaya Pyshma in Sverdlovskaya Oblast. The second largest in the country is the Balkhash refinery in Kazakh SSR. Other refineries are at Alaverdi in the Armenian SSR, Kyshtym in the Urals, Noril'sk in Krasnoyarskiy Kray, and Moscow. During 1959-65 the USSR plans to expand refining capacity, probably by about 50 percent. Capacity at Alaverdi is to be increased to five times the present size, capacity at both Balkhash and Noril'sk may be increased, and a new smelter and a refinery are scheduled to be built at Almalyk in Uzbek SSR.

For a listing of the copper smelters and refineries of the USSR, see Table 2,* and for an indication of the location of these facilities, see the map, Figure 1.**

II. Construction and Investment

An increase in production of copper in the USSR by the 90 percent called for in the Seven Year Plan will require a substantial expansion

* Table 2 follows on p. 10.

** Following p. 10.

Table 2

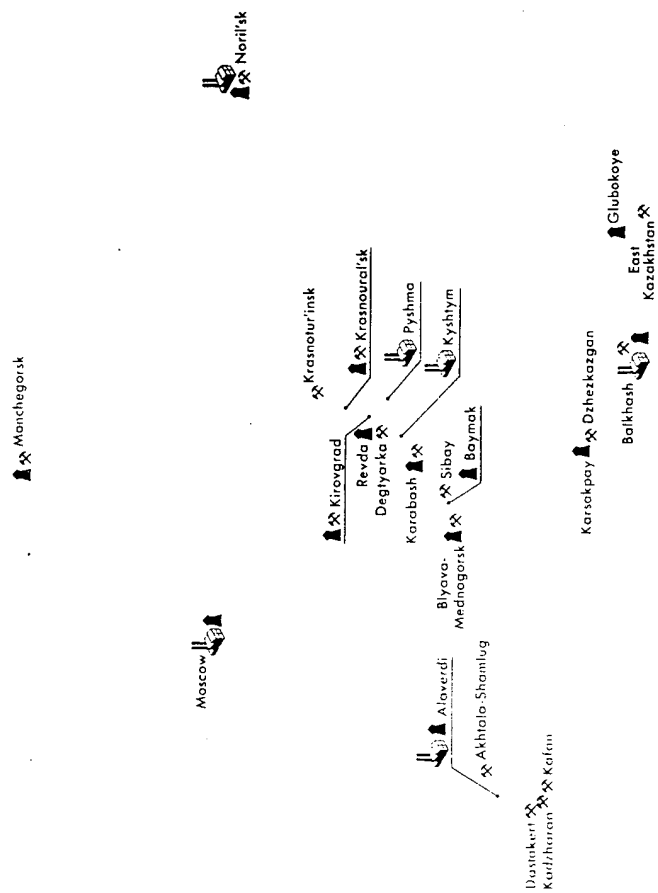
Mining and Concentrating, Smelting, and Refining Plants and Production
in the Copper Industry of the USSR
1958

Mining and Concentrating			Smelting		Refining	
Plant	Production of Copper Ore	Plant	Production of Blister Copper a/	Plant	Production of Refined Copper	
Achtala-Shaulug Dastakert Kadzharan Kafan	2,000	Alaverdi	15.8	Alaverdi	15.8	
Dzhezhbulagan East Kamdzharian Koundud	20,000	Karsakpay Clubokoye Balkhash	191.2	Balkhash b/	103.0	
Biyaya-Main-Gyrek Kazakh Kandakoye Sibay	3,000	Mednogorsk Kurabash Monchegorsk Raymak	35.0	Kyshtym	31.0	
Bagytaria Kirovgrad Krasnotur'sinsk Krasnoural'sk Tsim	5,500	Kirovgrad Krasnoural'sk Pevda	88.8	Pyshma b/	181.0	
Revillina	10,000	Noril'sk	48.0	Noril'sk	48.0	
		Moscow c/	27.5	Moscow c/	27.5	
Total	48,000		406.3		406.3	

a. Given in terms of refined copper.
b. The excess of blister copper over refined copper in Kazakh SSR is sent to Pyshma for refining.
c. Production at this plant is based primarily on scrap metal.

X Mining and concentrating

Smelting
Refining



of capacity in all sectors of the copper industry. Perhaps the greatest expansion will occur in the mining and concentrating sector, which has been lagging behind the metallurgical sector for several years. Refining capacity, however, may have to be expanded by only about 50 percent, inasmuch as existing refineries probably could produce 100,000 tons in addition annually.

Capital investment for the expansion program of the copper industry as a whole in the Seven Year Plan is estimated to amount to about 9.5 billion rubles.* A large share of this investment, perhaps 75 percent, probably will be used for the construction of new plants and the remainder to modernize existing plants. Of the total investment, nearly 350 million rubles may be expended to achieve an increase of 265,000 tons in new capacity for refining copper.**

* Ruble values in this report are expressed in current rubles. The official rate of exchange of 4 rubles to US \$1 does not necessarily reflect the dollar value. An approximate ratio for investment in the copper industry follows.

The figure of 9.5 billion rubles is based on an increase in production during the Seven Year Plan of about 365,700 tons of refined copper and on a capital investment figure reported by the USSR of 26,000 rubles per ton of new plant. ^{30/} The figure of 9.5 billion rubles is believed to include not only investment in refining facilities but also investment in all stages of the industry preceding the refining stage. Only if the ruble-dollar ratio between the USSR and the Free World for investment in refining facilities were something more than about 250 to 1 would the figure of 26,000 rubles apply to refining capacity alone. Such a ratio appears to be unlikely in view of the ruble-dollar ratio of less than 10 to 1 for investment in capital construction for the USSR as a whole.

** Information about investment in capacity for refining copper in the USSR is not available, and even for Free World countries such information is very sparse. In the early 1950's the Mufulira enterprise in Rhodesia invested 1.192 million pounds sterling (US \$3.3 million) in the construction of an electrolytic refinery with a capacity of 36,600 tons, or about \$91 per ton of refined capacity. ^{31/} To construct a refinery to produce 265,000 tons of refined copper would require, at about \$100 per ton, approximately \$26.5 million. At a ruble-dollar ratio of 13 to 1, this investment would amount to about 345 million rubles.

The Soviet investment coefficient of 26,000 rubles per ton of new capacity may be compared with a Free World figure of about \$2,000 per ton of new plants, including all sectors from mining through refining, thus indicating the above ruble-dollar ratio. The Free World figure of \$2,000 was derived by adding data about a large new Latin American copper-producing facility that [Footnote continued on p. 12]

Facilities for smelting may receive a slightly larger amount than the amount for refining capacity. On the assumption that smelting capacity amounting to 365,000 tons must be constructed, the investment would be about 1.65 billion rubles.* The remainder of the 9.5 billion rubles to be invested in the copper industry -- that is, 7.5 billion rubles -- may be directed to the mining and concentrating sectors.** Much of this investment may be required for facilities to process oxide ores by technologies different from those for sulfide ores. Table 3*** gives some indication of the emphasis on the development of the mining and concentrating sectors of the Soviet copper industry as opposed to the smelting and refining sectors and also of the regional location of the principal new facilities of the copper industry.

includes mining, concentrating, and smelting to data about the fairly new copper refinery built in Rhodesia. Approximately \$230 million are being invested in the Toquepela properties of the Southern Peru Copper Company to develop a mine, concentrating plant, smelter, roads, and ancillary facilities to produce annually about 120,000 tons of high-grade blister copper. ^{32/} Thus the investment coefficient is about \$1,917 per ton. It might be noted that at San Manuel in the US the cost was about \$118 million for a plant to produce about 63,500 tons of blister copper per year. ^{33/} The investment coefficient for this plant, therefore, is about \$1,858 per ton. Adding the investment coefficient of the Mufulira refinery to the coefficient of the average of Toquepela and San Manuel gives a Free World investment coefficient of nearly \$2,000 and a ruble-dollar ratio of 13 to 1.

* New capacity of 365,000 tons times \$347 per ton times 13 gives 1.65 billion rubles. The figure of \$347 per ton is based on an investment of \$25 million for the Hayden smelter (240 tons per day) and assumes a 300-day-per-year operation. ^{34/}

** A rough check on the investment in mining and concentrating indicates that 7.5 billion rubles could be of the right order of magnitude. The ruble investment would be equal to about \$577 million, on the assumption of a ruble-dollar ratio of 13 to 1. On the assumption that about \$100 million of the San Manuel investment is for mining and concentrating, the investment of \$577 million would provide about 5.8 times the capacity of San Manuel, or 58 million tons of ore and 174,000 tons of concentrate per year. The assumption is based on the subtraction from the total San Manuel investment of \$118 million of an amount equal to the investment coefficient of \$347 per ton of smelter capacity -- as at the Hayden smelter -- times the San Manuel smelter capacity of 63,500 tons. For the USSR to produce 772,000 tons of refined copper in 1965, production of ore must increase about 50 million tons.

*** Table 3 follows on p. 13.

Table 3

Expansion of the Copper Industry of the USSR During the Seven Year Plan
1959-65

Area and Location	Mining and Concentrating	Smelting	Refining
Armenian SSR			
Agarak	Construction of combine to be completed		
Akhtala	Concentrating plant to begin operating		
Alaverdi		Probably will expand capacity	To increase capacity by 80,000 tons above present capacity of 20,000 tons
Dastakert Kadzharan	Combine to be expanded Capacity of concentrating plant to be increased by 50 percent		
Urals			
Bashkir	Second and third sections of concentrating plant to be completed		
Gaysk	Concentrating plant under construction		
Mednogorsk	Combine to be reconstructed		
Uchaly	Combine to be expanded		
Volkov	Combine to be constructed		

Table 3

Expansion of the Copper Industry of the USSR During the Seven Year Plan
1959-65
(Continued)

Area and Location	Mining and Concentrating	Smelting	Refining
Kazakh SSR			
Balkhash Bozshakul'	Capacity of the entire plant to be increased by 50 percent Mining-concentrating combine to be completed		
Chetyr-Kul'sk Dzhezkazgan	Combine to be constructed Existing concentrating plant to be reconstruced and a new concentrating plant to be built	Smelter to be con- structed	
Nikolayevsk	Combine to be constructed		
Uzbek SSR			
Almalyk	Combine for mining, concentrating, smelting, and refining to be constructed		
Kola Peninsula Moscow	None	None	None
Krasnoyarskiy Kray	None	None	None
Noril'sk	Capacity of combine to be doubled; copper expansion unknown		

III. Consumption

The USSR has not published figures for any recent year on the demand for copper, the total amount of copper consumed in the country, or the amount consumed by any major consuming industry. In the absence of such figures, consumption has been estimated by an indirect methodology derived from an observable direct relationship between consumption of crude steel and consumption of refined copper. The relationship is believed to be causal: the specific properties of copper make it complementary to steel rather than competitive, as copper is with aluminum. The estimates of consumption are based on both observation and theory. Several statistical methods, including correlation, were used to evaluate the significance of the relationship between production of crude steel* and consumption of refined copper. Data for four highly industrialized countries (Canada, Japan, the UK, and the US) were analyzed, and in every case the results indicated that a significant relationship existed between these two factors. As a result of the findings for the other industrial countries, it was concluded that in a large industrial country such as the USSR, production of crude steel could be used as a basis for estimating consumption of copper.

Accurate data on production of crude steel in the USSR are available for 1929-58 except for 2 or 3 years during World War II, when there are uncertainties as to the dates that production ceased at some of the plants overrun by the invading Germans. Also, firm data are available on production, imports, and exports of copper during 1929-33. Although the changes in the level of stocks of copper are unknown, it is believed that the annual production plus imports minus exports (which were zero), averaged for the years 1929-33, will cancel any changes in stocks that may have occurred and therefore will indicate within reasonable limits the level of consumption of copper. Consumption of copper during 1934-55 was estimated on the basis of the increase in production of steel, using the average annual production of steel in 1929-33 as a base. Based on the methodology described above, consumption of copper in the USSR for 1954-59 and 1965 is estimated as follows:

Thousand Metric Tons			
<u>Year</u>	<u>Consumption</u>	<u>Year</u>	<u>Consumption</u>
1954	409	1958	577
1955	447	1959	629
1956	480		
1957	503	1965	929

* Production of crude steel is virtually equivalent to consumption of crude steel, inasmuch as crude steel in unfabricated forms normally is not exported or imported in significant quantities.

IV. Substitution

During the Seven Year Plan the USSR probably will make greater efforts than heretofore to substitute other metals and nonmetallic materials for copper in many applications. Khrushchev, in his speech to the Plenum of the Central Committee of the Communist Party in June 1959, stated that the government spends considerable gold to purchase badly needed copper. He went on to say that some of this copper is wasted on production of nonessential items and that aluminum and plastics ought to be used for many of these items. 35/

The finding of substitutes for copper is being taken seriously, as indicated by the fact that during 1959-65 more than 1 million tons of aluminum are planned to be used in the electrical networks of the country, partly as a substitute for copper as a conductor and partly as a substitute for lead as a sheathing material. Some indication of the importance of this substitution may be inferred from a Soviet statement that the utilization of aluminum and plastics in production of cable will save up to 10 billion rubles and will conserve more than 400,000 tons of lead and more than 400,000 tons of copper during the Seven Year Plan. 36/ Furthermore, the USSR appears willing to expend the effort necessary to obtain this aluminum. Whereas production of copper during 1959-65 is to be increased by 90 percent, production of aluminum is to be increased by 180 to 200 percent. 37/ Moreover, the investment in the aluminum industry is estimated to be about 20 billion rubles,* or about twice that in the copper industry. The reason for the relatively greater emphasis being given to the aluminum industry seems to be the lower costs of production for aluminum than for copper.

V. Trade

A. Imports

During the 6-year period 1954-59 the USSR was unable to obtain additional copper from the rest of the Soviet Bloc and imported nearly 550,000 tons of unwrought copper and copper wire from the Free World. These imports represented nearly 20 percent of its new supply (production plus imports) of copper in the period. Imports increased rather sharply in 1958 and constituted more than one-fourth of the

* This estimate is based on a Soviet figure of 20,000 rubles per ton for the creation of new capacity in the aluminum industry 38/ and an estimated increase in capacity of about 1 million tons required to meet the goal for production.

new supply of copper in that year. Imports of copper by the USSR during 1954-59 were as follows*:

Thousand Metric Tons			
<u>Year</u>	<u>Imports</u>	<u>Year</u>	<u>Imports</u>
1954	75	1957	85
1955	50	1958	150
1956	60	1959	125**

The form of the copper imported by the USSR has varied to a large extent with the export controls placed on the shipment of copper to the USSR from countries belonging to the Coordinating Committee (COCOM). Before August 1954, most of the Soviet imports of copper were in the form of unwrought copper. Following the removal from the embargo list by COCOM of wire 6 millimeters and less in diameter, the USSR imported most of its copper in the form of such wire. In August 1958, COCOM removed the export controls on all forms of copper. Subsequently the USSR imported more copper in unwrought forms in the last 4 months of 1958 than the total of such imports in all of the preceding 3 years. At the same time the USSR continued to import bare copper wire at about the same rate as in the first 8 months of the year. Available evidence indicates that Soviet purchases of copper from the Free World in 1959 may have been slightly less than in the preceding year and that the shift to purchases of unwrought forms of the metal continued.

B. Exports

During 1955-58 the USSR exported about 225,000 tons of copper, almost all of which was sent to other countries of the Soviet Bloc. Czechoslovakia and East Germany have been the two principal countries receiving the Soviet copper, accounting for nearly two-thirds of the total in the 4-year period. Both of these countries as well as most of the others in the Soviet Bloc exported to the USSR finished goods probably containing an amount of copper approximately equal to that received from the USSR. As far as these transactions are concerned, the supply position of the USSR is not affected, inasmuch as the USSR is, in effect, importing a service and "value added by manufacture."

* These figures are based on numerous statistics of Free World exporting countries. The USSR has not reported imports of copper in its official handbooks on foreign trade.

** Preliminary estimate.

VI. Relationship Between Supply and Consumption

Estimated consumption of copper in the USSR has exceeded estimated production for many years. Estimates for 1954-59 and 1965 are given in Table 4 and in the accompanying chart, Figure 2,* together with an indication of the gap between production and consumption. Part of the deficit has been met by imports, primarily from the Free World. The remainder probably was met by withdrawals from stocks, which were exceedingly large as a result of large imports of copper and brass during World War II from the US and the UK. Although there is no positive information that stocks of copper have been reduced by the quantities estimated in Table 4, the abundant evidence that a shortage of copper has existed in the USSR, at least in recent years, suggests that the direction of the stock changes is at least correct.

Table 4

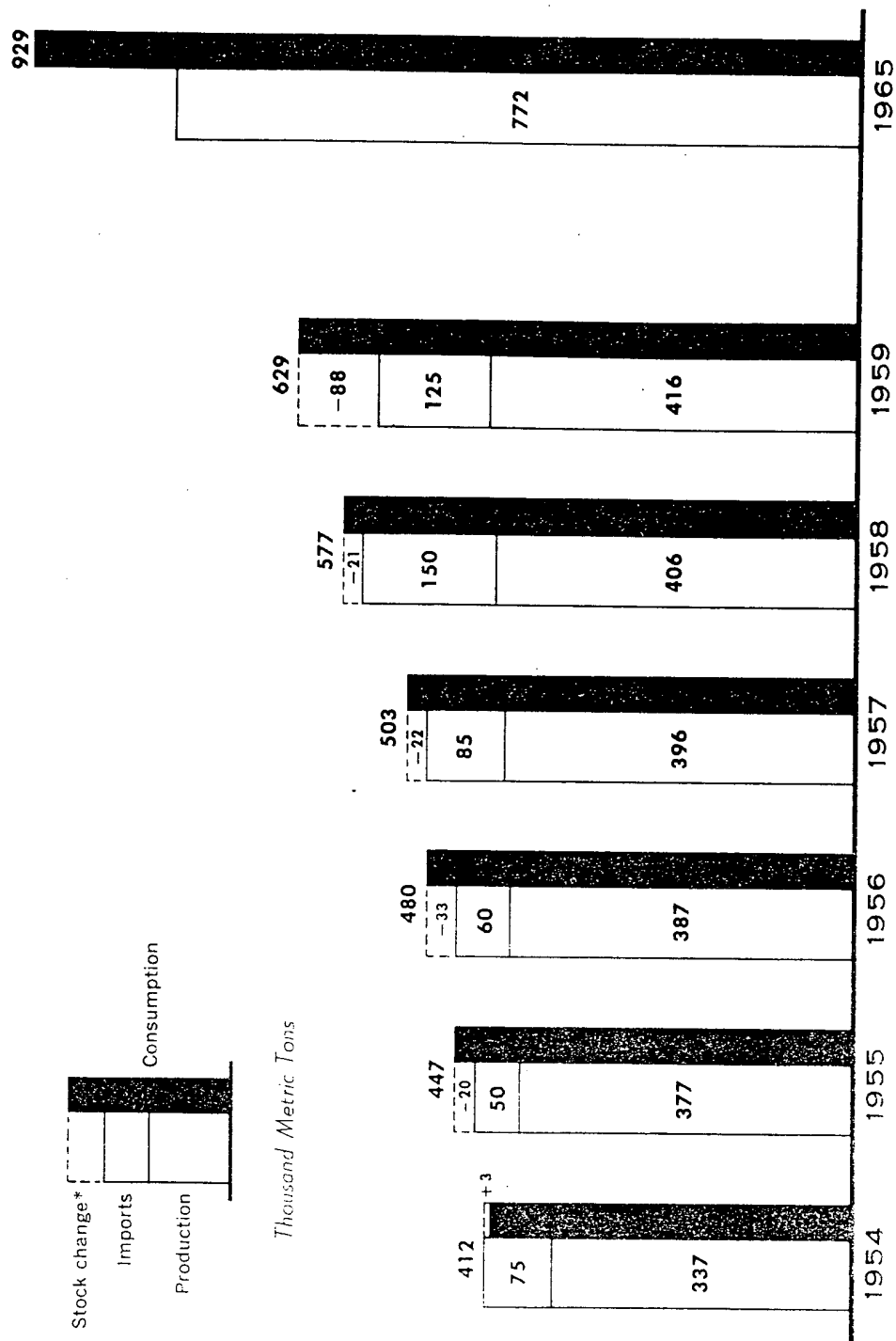
Estimated Supply and Consumption Balance
of Copper in the USSR
1954-59 and 1965 Plan

	Thousand Metric Tons						
	<u>1954</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1965 Plan</u>
Consumption	409	447	480	503	577	629	929
Production	337	377	387	396	406	416	772
Difference	72	70	93	107	171	213	157
Imports	75	50	60	85	150	125	N.A.
Stock changes	+3	-20	-33	-22	-21	-88	N.A.

* Following p. 18.

Figure 2

*Estimated Supply and Consumption Balance of Copper in the USSR
1954-59 and 1965 Plan*



*A plus figure indicates an addition to stocks, a minus figure indicates a withdrawal from stocks.

APPENDIX

SOURCE REFERENCES

1. USSR, Gosplan. Sotsialisticheskoye stroitel'stvo SSSR, Moscow, 1936, p. 19.
2. Izvestiya, 8 Feb 39.
3. USSR, Gosplan. Sotsialisticheskoye stroitel'stvo SSSR, 1933-38, Moscow, 1939, p. 62.
4. Industriya, 23 May 40, p. 3.
5. Pravda, 21 Feb 41.
6. Kazakhstanskaya pravda, 15 Aug 44.
7. Planovoye khozyaystvo, Mar 52, p. 47.
USSR, Geologicheskii Komitet. Godovoy obzor mineral'nykh resursov, Leningrad, 1926, p. 586.
8. Kazakhstanskaya pravda, 16 Aug 44.
9. Ibid.
10. Ibid.
11. Pravda, 21 Jan 47.
12. Ibid., 18 Jan 48.
13. Current Digest of the Soviet Press, 2 Feb 49, p. 38.
14. Ibid., 13 Mar 50, p. 16.
15. Ibid., 3 Mar 51, p. 3.
16. Pravda, 26 Feb 56.
17. Liteynoye proizvodstvo, Oct 57, p. 5.
18. Pravda, 29 Jan 52.
19. Ibid., 23 Jan 53.
20. Trud, 21 Jan 55.
21. Current Digest of the Soviet Press, 14 Mar 56, p. 23.
22. Kazakhstanskaya pravda, 18 Dec 55.
23. Planovoye khozyaystvo, Mar 52, p. 47.
USSR, Geologicheskii Komitet (7, above).
24. Kazakhstanskaya pravda, 28 Jan 49.
25. Ibid., 16 Dec 51.
26. Ibid., 18 Dec 55.
27. Pravda, 14 Nov 58.
28. Priroda, Nov 58, p. 6.
29. Gt Brit, BBC. Summary of World Broadcasts, pt I, "USSR," no 990, 12 Dec 58, p. 60.
30. Garbar, M.I. Plasticheskiye massy v narodnom khozyaystve (Plastics in the National Economy), Moscow, 1958, p. 13.
31. Journal of Metals, Feb 56, p. 234.
32. Parsons, A.B. The Porphyry Coppers in 1956, New York, 1957, p. 26.
33. Engineering and Mining Journal, Apr 56, p. 75-76.

34. Journal of Metals, Jun 59, p. 376-377.
35. Bakinskiy rabochiy, 3 Jul 59, p. 2.
36. Planovoye khozyaystvo, Jan 59, p. 19.
37. Pravda, 14 Nov 58.
38. Garbar, op. cit. (30, above).